Midwest ISO Markets

Michigan House Energy
and
Technology Committee
27 April 2005

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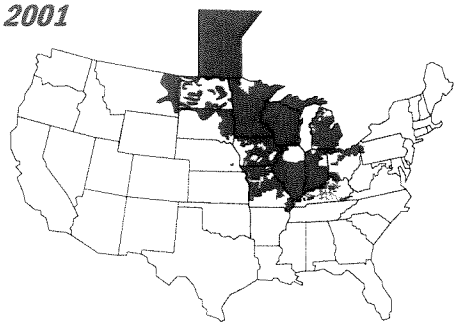
Who We Are

The Midwest ISO is an independent, non-profit entity that monitors the transmission grid of high voltage electricity across much of the Midwest.

Operational Since December 15, 2001

- 23 Transmission Owners
- 36 Control Areas
- 119,207 MW of peak load
- 137,000+ MW generating capacity
- 97,000+ miles of transmission lines
- 947,000 square miles
- 15.1 million customers
- 1,504 generating units in the reliability footprint
- Carmel and St. Paul Control Centers



Control Areas within the MISO Reliability Monitoring Area

Alliant Energy – East	MidAmerican Energy Company
Alliant Energy – West	Michigan Electric Coordinated System
Ameren Transmission	Madison Gas and Electric Company
Aquila Networks – Missouri Public Service	Manitoba Hydro, Transmission Services
Aquila Networks – West Plains Kansas	Minnesota Power, Inc.
Central Illinois Light Co	Muscatine Power and Water
Cinergy Corporation	Northern Indiana Public Service Company
Columbia Water & Light	Nebraska Public Power District
City Water Light & Power	Northern States Power Company
Duke Energy – Vermillion	Omaha Public Power District
Dairyland Power Cooperative	Otter Tail Power Company
First Energy Corp	Southern Indiana Gas & Electric Co
Great River Energy	Southern Illinois Power Cooperative
Hoosier Energy	Southern Minnesota Municipal Power Agency
Illinois Power Co	Upper Peninsula Power Co
Indianapolis Power & Light	Western Area Power Administration UGPR
Lincoln Electric System	Wisconsin Energy Corporation
LG&E Energy Transmission Services	Wisconsin Public Service Corporation

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The Role of RTOs

- Monitor flow of power over the grid
- Schedule transmission service
- Perform transmission security analysis for the Reliability Area footprint
- Manage power congestion through LMPs
- Approve transmission & coordinate generation maintenance outages
- Perform long term planning & analysis for region
- Operate Real-Time & Day-Ahead Markets

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Job #1-Reliability

The Midwest ISO has made tremendous strides to improve reliability in five key areas:

- Visualization Tools
- Reliability Tools
- Operator Training
- Communications
- Operating Agreements

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Visualization Tools

- Displays allow proactive system monitoring in much greater detail on wider geographic basis
- Much less dependent on local transmission monitoring
- Displays permit narrow viewing of smaller system segments to better identify specific problems
- Information is available on real-time megawatt and reactive power values, voltage profiles, and outage indicators

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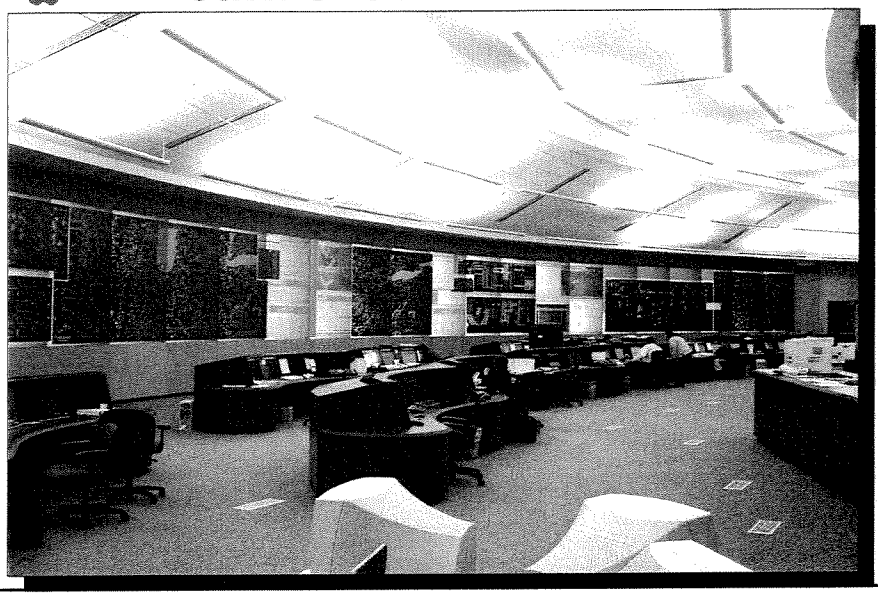
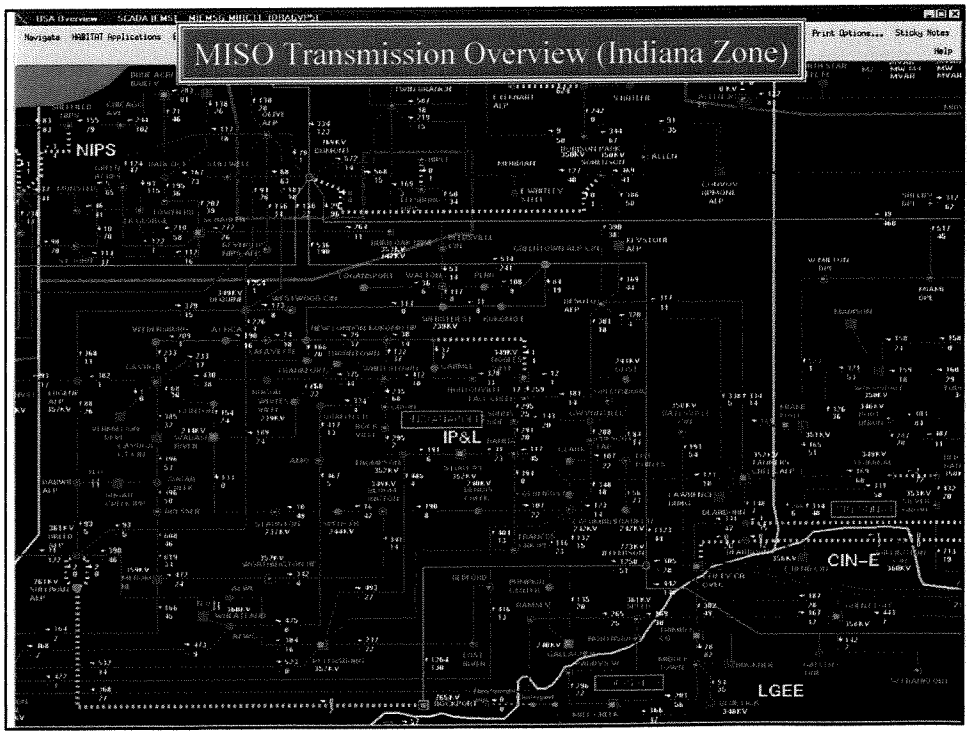
Carmel Control Center





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Reliability Tools

I. State Estimator

- Sophisticated mathematical formula digest raw data from tens of thousands of points along grid
- Data is used to develop contingency analyses for potential events that could compromise system reliability
- "What if" scenarios allow control room operators to evaluate status of system by simulating grid's response to hypothetical failures

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Managing Highly Complex Tasks

- 102,000 Real Time Data Points,
- 31,000 Busses,
- System Status Every 15 Seconds,
- Data Update Every 90 Seconds,
- 600 Flow Gate Continuous Assessment,
- 5,500 Contingencies Assessed Every 3 Minutes,
- Largest Working State Estimator in the World.

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II. **Topology Processor**

III. **Flow Gate Monitoring Tool**

IV. **Power Supply Monitoring Tool**

V. **Transmission "Delta Flow" Monitoring Tool**

VI. **Generation Monitoring Tool**

VII. **Redundant Monitoring Tools**

VIII. **Back-Up Capability**

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Enhanced Training

- Classroom Sessions
- EMS – based Simulator Training
- Emergency Response Drills
- System Dynamics Training
- Cross-Training with member Control Area Operators and Transmission Operators, and neighboring Control Areas and Reliability Coordinators.

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Formalized Communication Procedures & Protocols

- Defined Emergency Response Procedures with members
- Defined Conservative/Reliable System Operating Procedures
- Require Reliability Coordinators to post critical outages information to NERC
- Defined Formal Controls and Processes to ensure availability of Midwest ISO Network Applications

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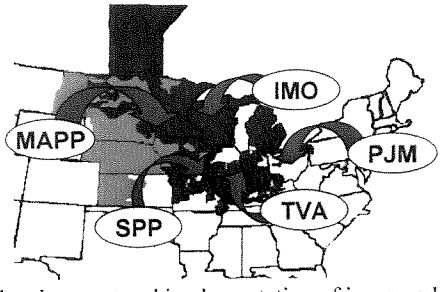
Midwest ISO Seams Coordination



- Leading the industry in development and implementation of improved information sharing, communications, and coordination:
  - RTO to other RTO/ISO's (PJM,SPP,IMO)
  - RTO to other Reliability Coordinators (TVA)
  - RTO to other Control Areas (MAPP)

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Regional Planning

- Regional planning process is "bottom-up / top-down"
- Midwest ISO rolls-up local reliability plans together with interconnection and transmission service requests
- Regional "Baseline" created by testing the rolled-up system against reliability criteria and adding as needed
- Regional plan presented to stakeholders including OMS before approval by Midwest ISO Board of Directors
- Projects in the approved regional plan are monitored for progress and completion
- Periodic status reports to Advisory Committee and Board
- FERC remedy when needs not met

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Roles & Responsibilities
Day 1 -- markets

Bilateral transactions facilitated by "physical" transmission service provided under regional OATT

MISO's primary responsibilities related to the market include:

- **Acceptance and analysis of requests to reserve transmission capacity for future scheduling of transactions**
- **Acceptance of schedules for approved reservations**
- **Monitoring transmission usage**
- **Providing reliability coordination**
- **Invoicing participants monthly for use of transmission lines as well as other associated services**

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Why markets? Why a Midwest ISO administered market?

- *Create a framework for robust, transparent and competitive electric markets.*
  - *Markets work better when there are many buyers and sellers*
  - *Competition yields lower prices*
  - *Sellers will build if there's an opportunity to earn a return commensurate with the risks.*
- *Competitive markets are efficient!*
  - *Maximizing consumer welfare*
  - *'Correct' allocation of scarce resources*
  - *Production at lowest cost*
- *Enhance system reliability*

Real-Time Centralized Dispatch

- MISO uses the Security Constrained Economic Dispatch (SCED) program every 5 minutes of each operating hour
- MISO sends control areas Net Scheduled Interchange (NSI) and basepoints for generators
  - NSI and resource basepoints sent every 5 minutes
  - Dynamic Schedules sent every 5 minutes
  - Ramped Control Area NSI sent every 4 seconds
  - Ramped Dynamic Schedule values sent every 4 seconds
- Control Areas will be responsible for regulation between dispatch interval and for operating reserves
- MISO calculates ex-post Real-Time LMPs based on actual system activity

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Other Market Design Elements

The Real Time market operator and the market participants want some certainty that enough resources are available every five minutes to meet the load demands, or to keep the lights on.

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Midwest ISO Energy Markets

- The critical design elements included in these Markets are:
  - Real-Time Centralized Dispatch
  - Integrated Energy and Congestion Management Day-Ahead Market
  - Locational Marginal Pricing (LMP)
  - Financial Transmission Rights
  - Reliability Assessment Commitment (RAC)
  - Self-Schedules and Bilateral Schedules
  - Use Limited and Demand Response Resources
  - Accommodate Retail Access Programs
  - Load Aggregation and Trading Hubs
  - Market Power Mitigation

  - Security Constrained Unit Commitment (SCUC)
  - Resource Adequacy
  - Pre-OATT Contracts (grand fathered agreements)
  - Ancillary Service Procurement
  - Control Area Activities

  - Market Settlements

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Day 2 Market Issues

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Day 2 Market Issues

Reliability Assessment Commitment (RAC) process: replacement reserves

Issues: commitment process

CT/GT commitment

The following principles have guided development of this RAC process:

- The RAC process should allow the Midwest ISO to commit the capacity it deems necessary to reliably operate the grid at the least commitment cost;
- The RAC process should have a transparent and equitable implementation process;
- The RAC process is not intended to create any 'new' markets outside of the existing proposed energy markets; and
- The RAC process should be incentive compatible with the Midwest ISO's proposed Day-Ahead and Real-Time Energy Markets;

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Day 2 Market Issues

Issue: reserve treatment-- Balancing Area/Midwest ISO coordination

The Reliability Charter

Midwest ISO & Balancing Area roles and responsibilities:

NERC Functional Model

- Reliability authority
- Balancing authority
- Interchange authority
- Real-Time security constrained economic dispatch

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The Reliability Charter

Midwest ISO & Balancing Area roles and responsibilities: Real-Time Energy Market

- Multi-Balancing Area Implementation
- The Midwest ISO will not directly control generation
- 5-minute LMP Base-points produced by the Midwest ISO and sent to Market Participants using 5-minute Load Forecast at Balancing Area granularity
- Net Scheduled Interchange calculated by the Midwest ISO and sent to each Balancing Area continuously
- Balancing Area performs regulation between 5 minute LMP base-points
- Generation limits sent by market participants has generation set aside for regulation and operating reserves "blocked off" from LMP dispatch

Day 2 Market Issues

Issues: unit characteristics

offer curves, start-up and no load offers

outage schedules

Next steps

Resource Adequacy: planning & operating reserves

The following principles have guided development of the Midwest ISO's resource adequacy proposal:

- The resource adequacy proposal should enhance system reliability and security;
- The resource adequacy proposal should not impose any additional costs for the Midwest ISO's market participants without a commensurate increase in system reliability;
- The resource adequacy proposal should not promote the abuse of market power.

Next steps

Resource Adequacy: planning & operating reserves

Interim Approach:

- Comply with existing RRO or state reliability requirements
- Standard setting responsibility
- Midwest ISO Designated Network Resources (DNRs)
- Must Offer requirements
- Midwest ISO role in RRO process

- Midwest ISO supply adequacy working group (SAWG)
- Organization of Midwest ISO States (OMS) resource adequacy working group
- OMS/SAWG principles & work plan

- **Expectation: MISO filing on permanent resource adequacy: mid-2005**

Next steps

Roles & Responsibilities Today – A/S

Per FERC Order 888, the Midwest ISO is required to offer six ancillary services

- Schedule 1 – Scheduling, System Control and Dispatch
- Schedule 2 – Reactive Supply and Voltage Control
- Schedule 3 – Regulation and Frequency Response
- Schedule 4 – Energy Imbalance
- Schedule 5 – Operating Reserve – Spinning
- Schedule 6 – Operating Reserve - Supplemental

Next steps

Ancillary Services at Energy Market Implementation

Operating reserve obligations met primarily through existing RRO reserve sharing groups

- Transmission customers continue to have option to purchase Schedules 5 & 6 from the Midwest ISO or may self-supply
- Reserve deployment treated as bilateral transactions outside of LMP settlement for predefined period following generation contingency
- Real-time LMPs reflect impact of lost resource following reserve deployment period

Next steps

Ancillary Services at Energy Market Implementation

- NERC/RRO Reliability Standard compliance remains responsibility of Control Areas, not the Midwest ISO. Need to define role of the Midwest ISO as agent in operating reserve deployment
- Existing Reserve Sharing Groups include non-Midwest ISO participants. Need to accommodate reserve sharing spanning RTO boundaries
- Release of operating reserves during energy emergencies (LMP impacts)

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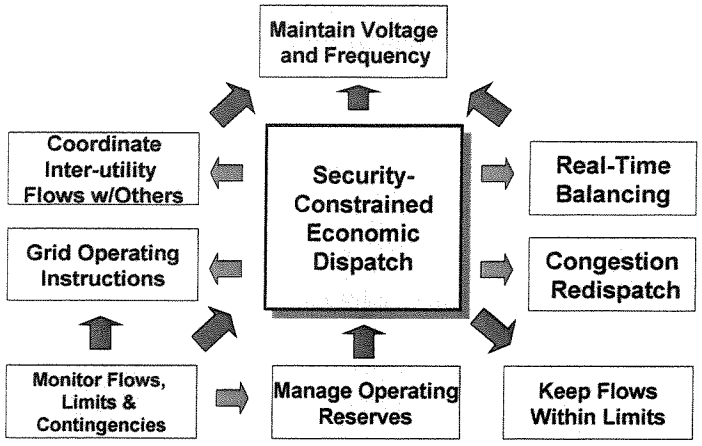
Improved Reliability Functions Center Around System Operations Dispatch



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Benefits for participants

- Reduced barriers to trade
  - Elimination of pancaked transmission rates
  - Uniform access -- one stop shopping for transmission service and interconnection
  - TLR replaced with market-based redispatch
- Coordinated markets
  - Liquidity/transparency
  - Expanded choices
    - Self-scheduled generation or load
    - Bilateral transactions
    - Spot purchases or sales
    - Forward hedging
    - Virtual transactions